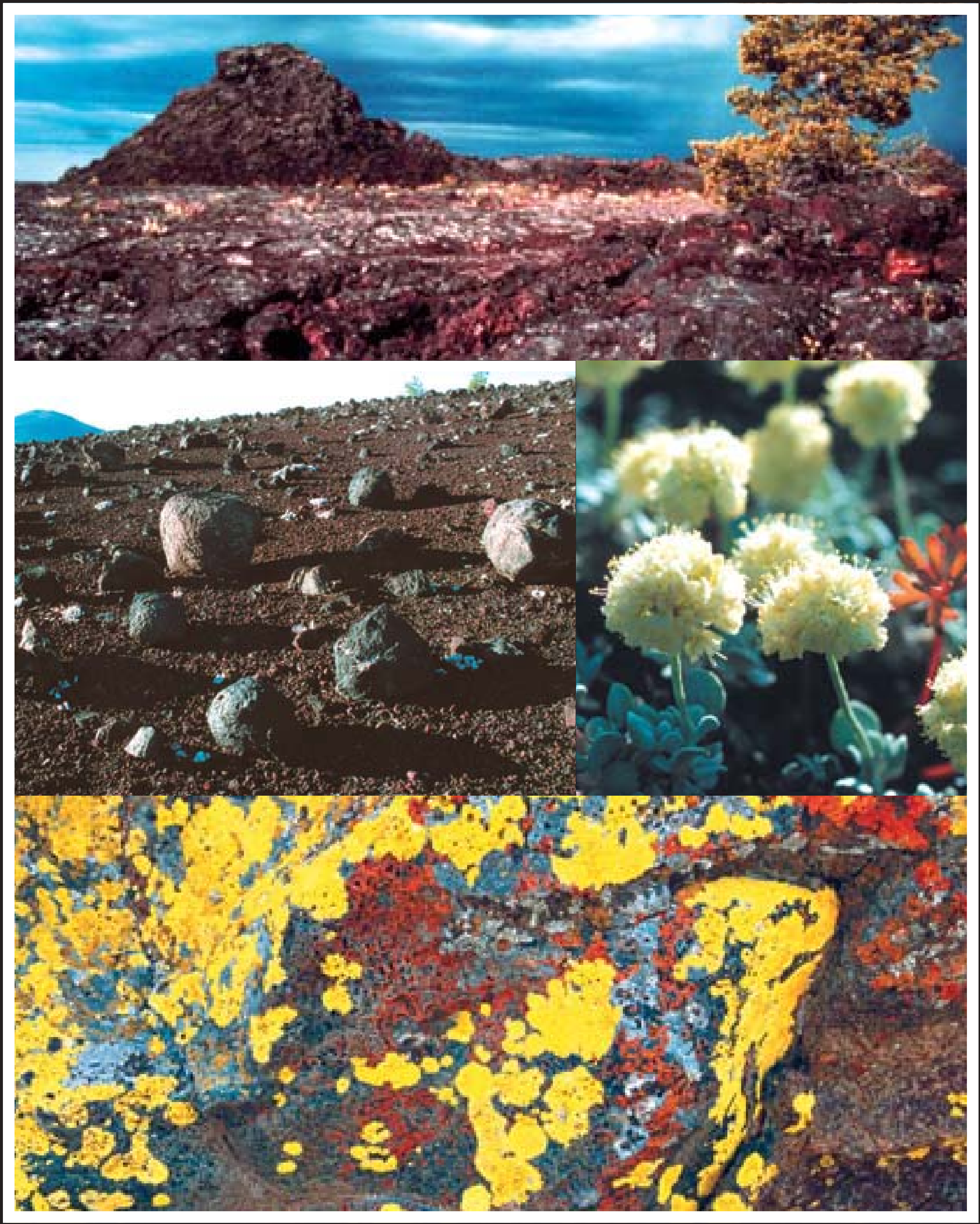
Chapter 3
Affected Environment



Previous page, clockwise, from top left
Hornito
Dwarf buckwheat
Lava lichen
Lava bombs

CHAPTER 3
AFFECTED ENVIRONMENT

The purpose of this chapter is to describe the physical, biological, cultural, and social environments of the Craters of the Moon National Monument and Preserve (the Monument), including human uses, that could be affected from implementing any of the alternatives described in Chapter 2. The topics discussed in this chapter are those identified as important issues by the public and the agencies during scoping. The discussion generally follows the order of the topics addressed in Chapter 2 under "Management Guidance Common to All Alternatives". The scientific names for species mentioned in the text are listed in Appendix D.

NATURAL RESOURCES

GEOLOGICAL RESOURCES

The purpose and significance of the Monument tie directly to its unique geology. Volcanism has generated an array of features and habitats that make the Monument a recognized outdoor laboratory. As a result, the Monument draws scientists and visitors from around the world to study and experience the diverse volcanic terrain.

Geologic Setting

The Monument is in the Snake River Basin-High Desert (Omernik 1986) and is primarily comprised of three geologically young (Late Pleistocene-Holocene) lava fields that lie along the Great Rift (see Figure 11 for regional setting and location). The Great Rift volcanic rift zone is a belt of open cracks, eruptive fissures, shield volcanoes, and cinder cones, which varies in width between approximately 1 and 5 miles. It begins north of the Monument, approximately 6 miles from the topographic edge of the Snake River Plain, in the vent area of the Lava Creek flows located in the southern Pioneer Mountains (Kuntz et al. 1992). The Great Rift extends southeasterly from the Lava Creek vents for more than 50 miles to somewhere beneath the Wapi Lava Field (Kuntz et al. 1982).

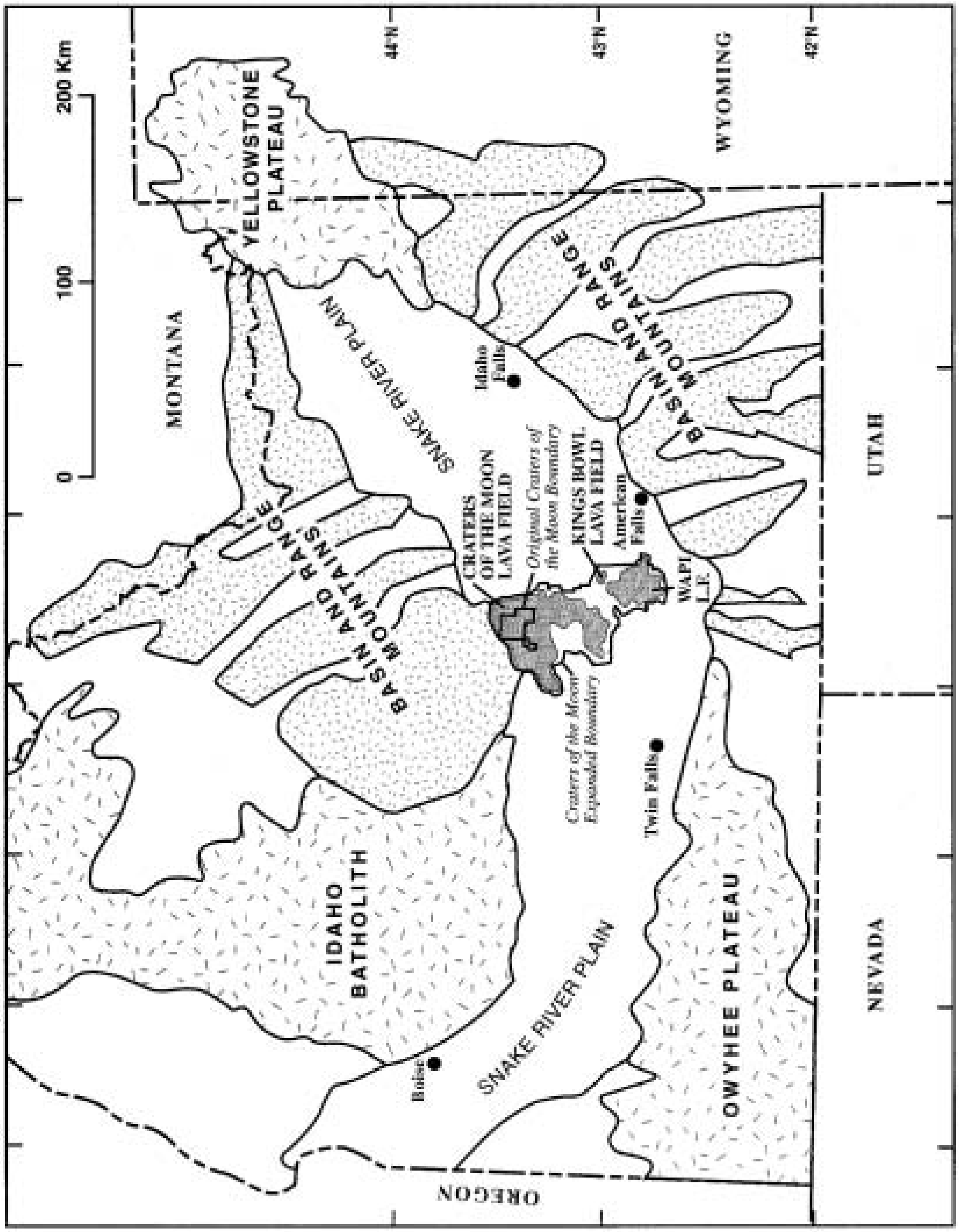
The Craters of the Moon Lava Field is the northernmost and largest of the three young lava fields. Kings Bowl Lava Field is the smallest and lies between Craters of the Moon Lava Field and the Wapi Lava Field. The rest of the Monument is composed of Pleistocene age pahoehoe and A?a flows, near-vent tephra deposits, cinder cones, lava cones, and shield volcanoes (Kuntz et al. 1988). These older areas are mantled with loess deposits (windblown silt) and in some places by windblown sand. During the Holocene (last 10,000 years), the most volcanic activity of any of the Eastern Snake River Plain (ESRP) basaltic rift systems was exhibited by these three lava fields associated with the Great Rift (Hughes et al. 1999).

The Craters of the Moon Lava Field covers 618 square miles and is the largest dominantly Holocene basaltic lava field in the lower 48 states (Kuntz et al. 1992). It contains a tremendous diversity of volcanic features, with nearly every type of feature associated with basaltic systems (Hughes et al. 1999). Contained within the Craters of the Moon Lava Field are at least 60 lava flows, 25 tephra cones, and eight eruptive fissure systems aligned along the northern part of the Great Rift (Kuntz et al. 1992).

Kings Bowl Lava Field formed approximately 2,200 years ago during a single burst of eruptive activity that may have lasted as little as six hours (Kuntz et al. 1992). Kings Bowl has a central eruptive fissure approximately 4 miles long, flanked by two sets of non-eruptive fissures. The dominant feature is a bowl, 280 feet long, 100 feet wide, and 100 feet deep, produced when lava came into contact with groundwater, causing a steam or phreatic explosion.

Adjacent to the bowl is an outstanding example of a lava lake with well-developed levees. The crust of the lake was broken by many of the blocks ejected by the phreatic explosion. The interior of this lake was still molten and oozed up through the holes punched in its crust, resulting in a large number of squeeze-up mounds of gas-charged lava (Hughes et al. 1999). Fissure caves, such as Crystal Ice Cave and Creons Cave, lie along the Great Rift at Kings Bowl. At South Grotto, the rift may be passable to a depth of 650 feet below the surface (Earl 2001). Feeder dikes and spatter cones can be seen along the Great Rift at Kings Bowl.

The Wapi Lava Field, approximately 2,200 years old (Hughes et al. 1999), is a classic shield volcano with a flattened dome shape. Kuntz et al. (1992) believe that the Wapi Lava Field began as a fissure eruption, but developed a sustained eruption from a central vent complex, which produced the low shield volcano seen today. Rising approximately 60 feet above the south side of the largest vent is Pillar Butte. Greeley (1971) reported that the only known dribblet spires in the continental United States occur on the flows associated with Pillar Butte. Now, however, dribblet spires are known to also occur in Diamond Craters in Oregon.



Note: L.F. = Lava Field

FIGURE 11
Regional Geological Setting and
Location of Craters of the Moon National Monument and Preserve

Potential for Future Eruptions

The Craters of the Moon Lava Field formed during eight eruptive periods with a recurrence interval averaging 2,000 years, and it has been more than 2,000 years since the last eruption. The constancy of the most recent eruptive periods suggests that slightly more than 1 cubic mile of lava will be erupted during the next eruption period.

In the past, eruptions in the Craters of the Moon Lava Field have generally shifted to the segment of the Great Rift with the longest repose interval. The next eruptive period should begin along the central portion of the Great Rift in the Craters of the Moon Lava Field, but may include the northern part of the Monument (Kuntz et al. 1986). Initial flows, based on past performance, will probably be relatively non-explosive and produce large-volume pahoehoe flows. Eruptions from potential vents on the northern part of the Great Rift may be comparatively explosive and may produce significant amounts of tephra, destroy cinder cones and build new ones (Kuntz et al. 1986).

Candy Kiss

Kings Bowl

Geologic Features

The lava is described by its physical appearance, which is largely determined by its composition, temperature, fluid and crystal content, and the influence exerted on it by the surface and slope it flowed down. Block lava has a surface of angular blocks and forms from very dense lava. A,a has a rough, jagged, or clinkery surface. Pahoehoe has a smooth, ropy, or billowy surface.

There are several types of pahoehoe. Shelly pahoehoe forms from highly gas-charged lava, often near vents or tube skylights, and contains small open tubes, blisters, and thin crusts. Some shelly pahoehoe crusts are so thin and fragile that they are easily broken by foot traffic; much of the shelly pahoehoe that surrounds Pillar Butte is like this. Spiny pahoehoe forms from very thick and pasty lava and contains elongated gas bubbles on the surface that form spines. Spiny pahoehoe is the dominant type of pahoehoe found in the Monument. Slabby pahoehoe is made up of jumbled up plates or slabs of broken pahoehoe crust. Many of the pahoehoe crusts are glassy and may exhibit various shades of blue or green prized by collectors. These glassy crusts are also prone to damage from foot traffic.

Pahoehoe

Lava tubes are hollow spaces beneath the surface of solidified lava flows, formed by the withdrawal of molten lava after the formation of the surface crust. Within lava tubes, various formations such as lava stalactites occur that are vulnerable to damage or theft.

Most of the lava flows in the Monument are pahoehoe and were fed through tubes and tube systems. Some lava flows produce tumuli (small mounds) or pressure ridges (elongate ridges) on their crusts. There are also pressure plateaus that were produced by the sill-like injection of new lava beneath the crust of an earlier sheet flow that had not completely solidified. In some places, squeeze-ups formed when pressure was sufficient to force molten lava up through tension fractures in the top of pressure ridges or cracks in the solidified crust of lava ponds. Because of their small size and unusual shapes, many of the squeeze-ups associated with the Kings Bowl Lava Field are vulnerable to theft.

When lava comes to the surface, highly charged with gas, and is ejected from one or a few vents, it can spray high into the air forming a fire fountain(s). The highly gas-charged molten rock cools and solidifies during flight and rains down to form cinder cones. Loose cinders are particularly vulnerable to compaction and wind and water erosion. Cinders displaying a play of colors, caused by a thin layer of glass, also make a tempting target for souvenir gatherers.

Other lava features include spatter cones that formed when fluid globs (spatter) were ejected short distances (generally less than 200 feet) from some of the vents and accumulated right around the vent, forming short steep-sided cones. Along eruptive fissures where a whole segment erupted, spatter accumulated to produce low ridges called spatter ramparts. Hornitos, also known as rootless vents, are similar in appearance to spatter cones, but formed from spatter ejected from holes in the crust of a lava tube instead of directly from a feeding fissure. The individual globs that comprise the spatter cones, spatter ramparts, and hornitos are frequently not very well adhered to one another and are easily dislodged, making them very vulnerable to human damage.

Four kinds of volcanic "bombs" are found in the Monument; all of which started off as globs of molten rock thrown or ejected into the air. The smaller bombs (backpack size or less) are frequently a target for collection and are now rare in proximity to roads and high-use trails in the Monument. The photo on page 77 depicts one type of bomb known as a "breadcrust bomb".

Caves

There are many different kinds of caves in the Monument. Shelly pahoehoe areas contain many small open tubes and blisters. There are thousands of these small open tubes and blisters within the Monument. The photo on page 84 depicts one cave known as Indian Tunnel.

Some fissure caves associated with the Great Rift can be passable to hundreds of feet below the surface. Earl (2001) reported at South Grotto in the Kings Bowl Lava Field that the Great Rift can be passable to a depth of at least 650 feet, depending on the internal ice conditions. Bears Den Waterhole,

Spatter Cone

Pressure Plateau

another fissure cave located in cracks of the Great Rift, is ice floored and usually a source of water even in a drought year.

The nature of flowing lava can produce shallow caves and overhangs at flow fronts as a result of inflation processes. Differential weathering of cinder layers on some cinder cones has also generated a few shallow caves. Some of these small caves are more than 10 feet deep.

These various types of caves in the Monument can also be associated with archaeological and paleontological features, and they can harbor wildlife such as the blind lava-tube beetle, bushy-tailed woodrats, and Townsend's big-eared bats. Deep cracks and fissures, including cracks with likely connections to lava tubes beneath, and the entrances to caves often create or provide microenvironments or microhabitats. Some of these microenvironments support impressive moss, algal, or lichen communities and even ferns.

Breadcrust Bomb

Indian Tunnel

People are attracted to caves, and some of the easily accessed caves in the Monument now contain considerable graffiti (e.g., Lariat Cave), litter, and other forms of vandalism.

Paleontology

Tree molds are impressions in the solidified lava that form as trees are enveloped by the lava flows, begin to burn, release water and other vapors that quickly cool the surrounding lava, and leave behind a mold of the charred tree and occasionally some carbon residue (see photos on page 84). Generally, tree molds preserve impressions of the cracked, partly burnt wood, but do not preserve bark or other textures that would aid in the identification of tree species. In the northern end of the Monument, more than 100 tree molds have been identified. Of the more than 100 inventoried tree molds, 11 showed minor damage from humans, and these were at developed sites.

Animal bones accumulate in lava tubes as inhabitants die naturally and are also introduced into the caves as a result of human or animal disposal. Exploration of such deposits in the lava tubes of the Snake River Plain has revealed bones of extinct animals such as mammoth and camel and modern large animals such as grizzly bear, gray wolf, bison, elk, and pronghorn (Miller 1989). In addition to lava tubes, lava blisters have also accumulated a faunal record. The openings create an excellent

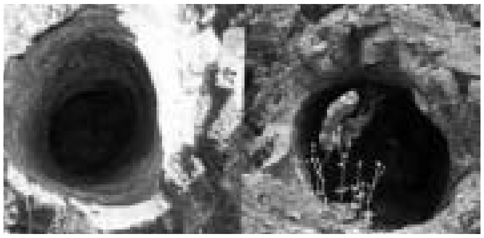


Photo above. Vertical tree nol on left is 8 feet deep and over 1 foot wide; horizontal tree nold on right is almost 2 feet wide. Photo on right. Mold of charred wood: hiking staff for scale.

trap for larger animals. Carnivores found in these blister traps on the ESRP include the now extinct noble marten and animals no longer found in the area such as bison, wolverine, and Canada lynx (Miller 1989).

A third type of unaltered fossil accumulation occurs in packrat nests. These nests, or middens, are an important contributor to the fossil record because of the ability to date the pollen and bone assemblages and relate that information to the paleoecology of the area.

SOILS

The soils of the Monument area are variable, reflecting the differences and interactions between parent material, topography, vegetation, climate, and time. The most significant differences involve the presence or absence of lava flows and the degree of soil development on volcanic substrates. The lava flows, which occupy two-thirds of the Monument, are made up of basalt lava rock. The soils on the younger basalt flows and cinder beds are limited to the initial decomposition of rock and cinders and deposition of windblown loess within crevices, cracks, and fissures. Plants can establish and grow in little to no soil. As time progresses, soil development continues and more vegetation establishes.

Sagebrush steppe, mountain areas, and kipukas within the Monument have deeper, well-formed soils. The high desert environment results in lighter colored soils with low organic matter content. Most of the soils in the Monument area are silt loam to sandy loam in texture and vary in depth. They are moderately drained to well drained, except where clay horizons are present. Soils that are disturbed, not properly vegetated, or located on steep slopes are susceptible to water and wind erosion.

Soil Origins

The soils in the Monument and surrounding area have developed from rocks deposited during a sequence of geologic events that began almost 600 million years ago, during the Cambrian Period. For approximately 500 million years, ancient seas intermittently covered the region, depositing limestone and other sedimentary rocks typical of ocean floors (Shallat and Burke 1994). Beginning about 17 million years ago, fault block mountain building has pushed up the rocks, exposing them to weathering and soil development processes. The many mountain ranges in the Basin and Range Province have developed in this way. Recent earthquake activity is evidence that these mountain-building processes continue today.

During the latter part of the Tertiary Period, from about 16 million years ago, until recently in the Yellowstone area, explosive volcanic activity across the Snake River Plain deposited layers of pyroclastic tuffs and silica rich lavas. More recent basalt lava flows and windblown loess have subsequently covered these rhyolite rocks. The basalt flows that are visible on the surface of the majority of the Snake River Plain began approximately 2 million years ago, during the Pleistocene, and continued until very recent times.

The lava flows on the Snake River Floodplain are approximately 1 million years old (Anderson et al. 1996). This volcanic activity built up the central part of the plain, forming some internally drained basins within, such as Big and Little Lost River sinks.

During recent times, the region has periodically received layers of windblown dust from sources further west. These loess deposits have mantled the local geology and have resulted in many of the deeper soils on the eastern Idaho foothills and the leeward sides of lava flows within the Snake River Plain.

Soil Types

Soil surveys have been completed and published by the Natural Resource Conservation Service (NRCS) for most of the Monument outside of the recent lava. Other portions of the area have been partially mapped at different times by the Bureau of Land Management (BLM) in the late 1980s and 1990s. Many of the soils surveys are now in Geographic Information System (GIS) form, where they can be viewed in Arcview and other GIS software.

Soil types in the Monument fall into the following categories:

- **Soils of the Mountains and Foothills** – These soils are located primarily in northern part of the Monument. They have developed in mixed metamorphic and/or volcanic shallow, rocky material and have carbonate accumulations at depth. Typical vegetation includes sagebrush mountain shrubs and tree types found native to eastern and southern Idaho.
- **Soils of Alluvium from the Mountains and Streams** – These soils have developed in lime-rich alluvial materials eroded from the mountains on the Snake River Floodplain and streams. Typical shrub vegetation includes mountain or Wyoming big sagebrush, low sagebrush, and occasionally some basin big sagebrush.
- **Shallow Basalt Soils** – This is a complex of soils developed on the recent basalt flows. Due to the uneven, broken surface of the basalt, soil depths range from a few inches on exposed ridges to 6 or 8 feet on the lee sides of the ridges and in low-lying areas. The type of vegetation varies depending on soil depth and may include various types of shrubs including fern-bush, syringa, and mountain big sagebrush, with some low and Wyoming big sagebrush.
- **Loess Soils** – The loess soils are from glacial Snake River silts and lacustrine materials that have been windblown out of the Snake River drainage. Typical shrub vegetation includes mountain big sagebrush, Wyoming big sagebrush, basin big sagebrush, or some threetip sagebrush.
- **Sandy Soils and Playa Lake Bottoms** – These soils have formed in alluvial and eolian accumulations usually near dry lake bottoms. The sands have weathered from quartzite, basalt, and sedimentary rocks, generally of local origin (Nace et al. 1975). Typical shrub vegetation includes basin big sagebrush or Wyoming big sagebrush.
- **Cinder Soils** – This is a complex of soils mapped by NRCS and particular to cinder cones and deposits located within the Monument. Soils within this complex consist of varying ratios of cinder and eolian loess accumulations. Typical vegetation includes dwarf buckwheat, antelope bitterbrush, mountain big sagebrush, and limber pine.

Biological Soil Crusts

Biological soil crusts are a feature common to nearly all plant communities in arid and semiarid regions throughout the world (Belnap et al. 2001). The development of biological soil crusts is dependent on a number of factors, including soil texture and chemistry, annual precipitation amount and timing, associated vegetation, and disturbance history. Biological soil crusts have not been observed as a highly conspicuous element in the Monument, which could be due to any one of these elements.

Soil textures in the Monument range from fine- to coarse-textured, with silt loams and sandy loams being predominant in areas where biological soil crusts are most likely to occur. Coarse-textured soils are more difficult for biological crusts organisms to stabilize due to the size of the particles. While crusts occur on soils with a variety of chemical natures, they tend to be highly developed on soils with basic pH and that are more saline or calcareous. Mosses are often a dominant organism on soils with neutral to acidic pH. Annual precipitation in the Monument averages from 8 to 16 inches. Areas with approximately 14 inches of annual precipitation have vegetation of a density where crusts are no longer needed to stabilize the soil surface.

The presence or absence of biological soil crusts on the Monument landscape depends on a variety of environmental factors as well as land use and fire history. While several BLM-administered areas and some kipukas in the Monument do not show good development of biological soil crusts, more areas, particularly in the drier southern portions, need to be investigated to determine the potential for crusts development. For example, areas with non-sprouting basin and Wyoming big sagebrush need to be compared with similar areas supporting the re-sprouting threetip sagebrush to determine if areas with a naturally shorter fire cycle (as indicated by the re-sprouting shrub) might have less potential for crust development than areas with longer historic fire return intervals.

VEGETATION, INCLUDING SPECIAL STATUS SPECIES, AND FIRE MANAGEMENT

Although some of the younger lava flows are devoid of vegetation, there is a surprising diversity of plants and plant communities in the Monument. The type and density of vegetation varies widely, depending on the availability of soil. The lavas and kipukas (islands of vegetation surrounded by younger lava flows) show a full range of ecological succession – from pioneer plants, such as lichens and mosses on the basalt surfaces, to complex plant communities in the kipukas and rangelands bordering the lava flows. The rough topography of the lava flows creates numerous microsites where soil and water accumulate to support plants that would normally occur in higher precipitation zones.

Limber pine stands occur on the cinder cones and lava flows in the northern part of the Monument. The transition between limber pine and juniper vegetation types occurs between Blacktail Butte and the original Monument. This ecotone normally occurs only in montane regions and is thus an unusual feature for the lava flows (BLM 1980). Quaking aspen and Douglas fir stands are found on some north-facing slopes in the northern portion of the Monument. Riparian and wetland habitats are limited to the northern periphery due to the geology, topography, and climate of the area.

Early successional plant communities on the cinder cones produce stunning spring wildflower displays. A areas with greater soil development support the sagebrush steppe vegetation that typifies the Snake River Plain. Sagebrush steppe is found on approximately 60 percent of the Monument and covers the more developed soils of the rangelands, kipukas, cinder cones, older lava flows, and the foothills of the Pioneer Mountains. This once was the most common vegetation throughout the Snake River Plain, as well as in the Intermountain West and Upper Columbia River Basin. However, fire, agriculture, and livestock grazing have modified composition and reduced the extent of this vegetation type throughout these regions (Blaisdell et al. 1982; Whisenant 1990; Bunting et al. 2002).

Some of the kipukas and portions of the original Monument have not been grazed by domestic livestock and have seen little in the way of other human-related disturbances. Thus, these areas, which are protected by new, rough lavas, offer some of the best remaining examples of native sagebrush steppe for the Snake River Plain. They are valuable as examples of range conditions before European-American settlement and the introduction of domestic livestock, and they offer an opportunity to observe climax vegetation, as well as successional processes associated with natural disturbances such as fire.

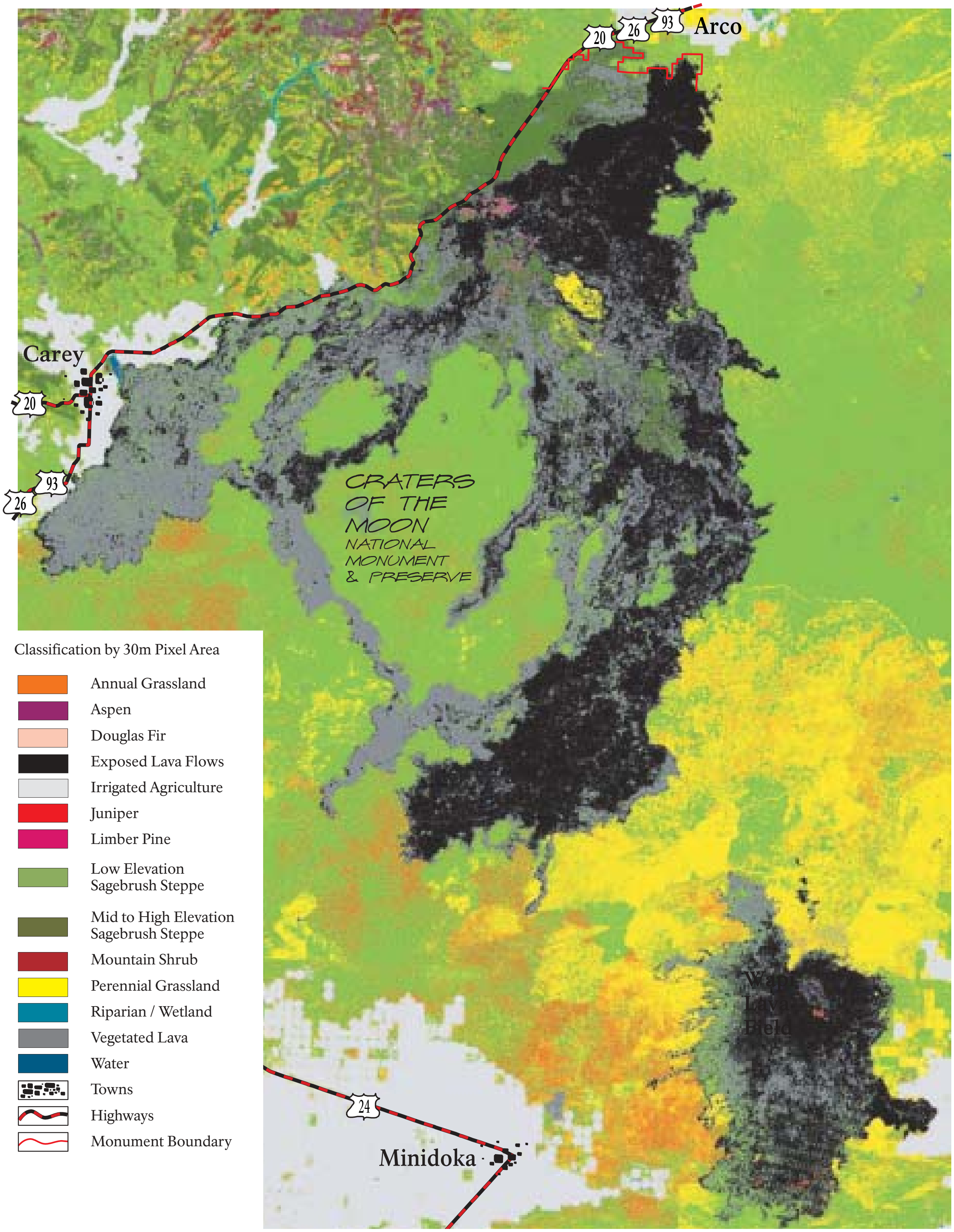
Vegetation in the original Monument and parts of the expanded Monument has been inventoried and mapped through various efforts (Day and Wright 1985; Whipple 1992; Jurs and Sands 2003). A recent vascular plant inventory effort estimates the presence of more than 600 species and at least 35 vegetation communities within the Monument (NPS, unpubl. data). The current vegetation map of the Monument was created with the use of LandSat imagery.

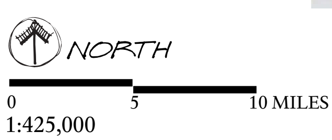
Data from the various vegetation studies, as well as inventory and monitoring points, were used to define spectral signatures. Vegetation inventory and ground-truthing of the map are ongoing; the vegetation map is a dynamic resource. This map, which is relatively broad in scale, is intended to provide a frame of reference for vegetation distribution and diversity within the Monument. The following discussion describes complexes that group and define the various vegetation types illustrated on the map.

Vegetation Types in the Monument

–Vegetated Lava Complex

Exposed lava flows are the newest lava flows or rough A'a flows that are mostly devoid of vascular plants; however, lichens and mosses are frequently present. Based on statewide Gap Analysis of Idaho Land Cover from 1996, approximately 20 percent of the Monument is exposed lava flows and 33 percent is vegetated lava (Landscape Dynamics Lab 1999). Vegetated lava is defined as lava fields with greater than 5 percent total vegetative cover, with plants occurring as islands, pockets, or clustered individuals in the lava flow. The vegetated lava complex mainly consists of early successional and adaptable plants that grow in the limited soil that blows into the cracks and fractures on young basalt rock.





No warranty is made by the Bureau of Land Management or National Park Service for use of the data for purposes not intended by these agencies. Frontcountry and Passage Zone polygons have been oversized for graphic presentation and are not to scale.

FIGURE 12

Vegetation Type Classification

Craters of the Moon National Monument & Preserve

U.S. Department of the Interior / National Park Service

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